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INDEX

1. Electron-Microscope Investigation of Steel Structures by N N Buynov and R M Lerinman. Doklady Akademii Nauk SSSR 62 (1948) no. 5, pp 629/632

   A. A study of the suitability of collodion replicas. Four samples were examined; bainite in a low-alloy steel; high speed steel; "troostite" in a carbon tool steel; martensite in a chromium-manganese bearing steel. The latter photomicrograph was stereoscopic. It was concluded that the collodion replicas gave satisfactory results, and that some details were revealed that were not visible with the ordinary microscope.

   B. This paper is obviously merely an exploratory study to determine the utility and limitations of collodion replicas. It does not present anything new but apparently was undertaken to clarify conflicting reports in the literature as to the contrast and resolution obtained with such replicas. Considerable progress has been made since the time this paper was written; Formvar is now generally preferred to collodion.

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C. The Soviets at this period appear to have been at the stage where the USA was from about 1941 to 1947; namely, major attention was being given to the development of techniques of specimen and replica preparation. Since that time, the emphasis in the USA has been mainly on the application of these established techniques to the solution of various metallurgical problems.

D. The reproduction of the figures in the photostat is too poor to permit evaluation of the quality of the original photomicrographs.

25X1 E. [redacted] it might be presumed that no Soviet electron microscope was available in 1948. Another indication of the limited amount of work done previously in the USSR on electron microscopy is the fact that only three of the eight references are Soviet.

2. Resistance of Metals to Plastic Deformation by Yu I Yagn and I A Chaplinskiy. Doklady Akademii Nauk SSSR 90 (1953) no. 6, pp 1023/1026

A. Technically pure iron, low-carbon steel, heat-treated chromium-manganese-silicon steel and aluminum bronze were tested in linear tension and compression; restrained compression; biaxial and triaxial compression. The results are plotted according to various mathematical formulas to determine which one is most satisfactory.

3. The Role of Grain Boundaries in the Process of Plastic Deformation of Aluminum by E S Yakovleva and M V Yakutovich. Doklady Akademii Nauk SSSR 90 (1953) no. 6, pp 1027/1029

A. Tests were made on coarse-grained pure aluminum. One series involved a constant rate of elongation (24%/hr) at 20/600 C; the other, slower tests under constant load at 400/600 C.

1) The role of grain boundaries in plastic deformation depends on the conditions of deformation. This variation is explained by a change in the mechanism of plastic deformation from slip at low temperatures and high rates of deformation to atomic diffusion at high temperatures and low rates of deformation.

2) At low temperatures and high rates of deformation, the grain boundaries seem to present an obstacle to deformation by slip. This hindering action of the grain boundaries decreases with increasing temperature.

3) At high temperatures and low rates of deformation, the boundaries are weaker than the grains, and appreciable localized deformation occurs at the boundaries.

B. This study is along the lines of the recent work of Grant and his associates at MIT but is far less comprehensive. Yakovleva and Yakutovich have not made clear the fact that grain-boundary flow is not directly related to the absence of slip bands. Also they appear not to have taken into consideration grain-boundary migration and the driving forces in back of it.

I S Servi and N J Grant: Structure Observations of Aluminum Deformed in Creep At Elevated Temperatures. TAIME 191 (1951) pp 917/922
H C Chang and N J Grant: Observations of Creep of the Grain Boundary in High Purity Aluminum. TAIME 194 (1952) pp 619/625
N J Grant, I S Servi and A Chaudhuri: Slip and Grain Boundary Sliding as Affected by Grain Size. TAIME 197 (1953) pp 217/218
H C Chang and N J Grant: Grain Boundary Sliding and Migration and Intercrystalline Failure Under Creep Conditions. TAIME 197 (1953) pp 305/312

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C. Only about a fourth of the references are Soviet. (The first reference under (6) appears to be a Soviet reference but - oddly enough - it has been transliterated.) Although non-Soviet references as recent as 1952 have been used, Yakovleva and Yakutovich seem to be unaware of the very pertinent 1951 and 1952 papers listed above.

4. Decomposition Potentials of the Systems NaF - ZrF_4 and NaF - ZrF_4 - ZrO_2, by Yu K Delimarskiy, A A Kolotiy and V A Lapa. Ukrainskiy Khimicheskiy Zhurnal 19 (1953) no. 4, pp 372/376

A. Metallic zirconium, used in some industrial fields, is generally obtained by sodium reduction of the fluoride. A second possible method might be electrolysis of fused salts, in which case chlorides and fluorides would come into consideration. Chlorides are too volatile but fl[uo]rides might be suitable. Decomposition potentials of various mixtures of fused salts were determined. Zirconium was deposited on the cathode during the electrolysis of these systems.

B. The amount of zirconium deposited appears to have been very small. Actually, in the ternary system, the assumption that the deposit was zirconium was based on theoretical reasoning. In the binary system, the conclusion was "confirmed" by the fact that the deposit burned with a bluish flame and did not give an alkaline solution in water. Also no details on the physical character of the deposit are given.

C. This information does not appear to be very startling. It has been known for some time that zirconium can be obtained by the electrolysis of a number of fused salt baths containing zirconium halides or double halides with or without the addition of zirconium oxide. Until recently, none of the reported attempts has produced metal in this way that has subsequently yielded a ductile product. Hayes and Stephens mention two recent investigations that look promising. One involves an all-chloride bath; the other uses a fused sodium chloride bath with K_2ZrF_6. Both operate in controlled atmospheres, a factor not mentioned by Delimarskiy, Kolotiy and Lapa.

E T Hayes and W W Stephens: The Metallurgy of Zirconium. Metal Progress 63 (1953) no. 5, pp 97/110

D. The chief method of producing zirconium in the USA appears to be the Kroll process, where the sponge is produced by magnesium reduction of zirconium chloride. Sodium reduction of the tetrachloride is one of the methods of obtaining the starting material for the iodide process, the other main production method used here. As far as is known, sodium reduction of the fluoride is not being used commercially in the USA.

E. No further indication is given of the "industrial fields" where metallic zirconium is applied in the USSR. In the USA the major use of metallic zirconium is as a material of construction for nuclear reactors.

5. Solubility of Chemical Elements in Chromium by I I Kornilov. Izvestiya Akademii Nauk SSSR Otdeleniye Khimicheskikh Nauk (1953) no. 6, pp 980/987

A. The solubility is evaluated on the basis of three criteria:

1) proximity in the periodic system;
2) small difference in relative atomic diameters (up to 8 to 10% for continuous solid solutions; to 14 to 16% for limited solid solutions);
3) isomorphism of crystal lattices (for continuous solid solutions).

These theoretical conclusions are supplemented by experimental data where available. Twenty elements form limited solid solutions with chromium; five form continuous solid solutions (alpha iron; molybdenum; tungsten; beta titanium; vanadium).

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B. Basically this is the same approach as that used by Kornilov for other elements, and the same general comments apply here as have been given in previous reviews of six of these papers.

I I Kornilov: Solid Solutions - Classification of the Solubilities of Elements in Iron. Iron and Steel 19 (1946) no. 2, pp 52/56 (translated from Izvestiya Akademii Nauk USSR 1945 (Khim), (2), 104)

I I Kornilov: Classification of the Solubilities of Elements in Iron, Report III. Partial Solid Solutions of Iron. Izvestiya Akademii Nauk, USSR, Otdelenie Khimicheskikh Nauk, 1948, No. 4, p 369 (translation of conclusions and one table)

I I Kornilov: Classification of the Solubilities of the Elements in Iron. Report IV. Partial Austenitic Solid Solutions of Iron. Izvestiya Akademii Nauk USSR, Otdenie Khemischeskikh (sic) Nauk, Sept-Oct 1949, pp 449/459 (translation of conclusions and two tables)

I I Kornilov: Solid Solutions of Nickel. Izvestiya Akademii Nauk, Otdelenie Khimicheskikh Nauk, 1950, No. 6, p 582 (translation of conclusions and two tables only)

I I Kornilov: Solubility of the Elements of Mendeleen's (sic) Periodic System in Nickel. Izvestia Akademd (sic) Nauk SSSR, Section of Chemical Sciences, No. 5, 1950, p 475 (translation without references)

I I Kornilov: Continuous Solid Solutions of the Metals of the Transition Groups of Mendeleev's Periodic System of the Elements. Dokladi Akademii Nauk, SSSR, New Series, Vol 73, July 21, 1950, pp 495/497 (translation)

C. The Soviet interest in metallic chromium and chromium-base alloys is shown by the publication at about the same time of this paper and the Kornilov-Mikheyev work on the constitution diagrams of chromium alloys. The general subject of chromium-base alloys has been discussed in the review of the latter paper. It has since been learned that ductile fine wire of chromium has been prepared by electrolytic etching but this does not materially change the picture, particularly in respect to the possible embrittlement in service at high temperatures.

I I Kornilov and V S Mikheyev: Constitution Diagrams of Metallic Systems Based on Chromium. Uspekhi Khimii 22 (1953) pp 87/98

D. The present paper, however, introduces a new aspect by pointing to the similarity of chromium, molybdenum and tungsten. Kornilov emphasizes the interest presented by the high melting point, strength and chemical stability of these three elements, and indicates that alloys based on these elements may find wide use in various fields of Soviet technology.

1) The reference to the good chemical stability of these three elements is rather misleading since chromium has good resistance to oxidation at elevated temperatures, whereas neither molybdenum nor tungsten has. As a matter of fact, wide use of molybdenum and its alloys at elevated temperatures has been held back mainly by the problem of finding either suitable coatings to prevent this oxidation or molybdenum-base alloys that are oxidation resistant. At present, the former approach appears most promising.

2) In the USA there has been some interest in chromium-base alloys as indicated in the review of the Kornilov-Mikheyev paper but more attention has been given to molybdenum. Tungsten has received relatively little consideration because of its higher specific gravity as well as uncertainties of supply.

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3) Kornilov does not mention the relative supply of these three elements in the USSR. Presumably chromium would be more available than the other two elements. The use of any of these elements as the base for alloys would of course require much larger supplies than the use merely as an alloying element.

6. J Chudoba: Electro-Erosive Metal Removal. Schriftenreihe des Verlages Technik vol 94. VEB Verlag Technik Berlin (1953) 107 pp (translated from Czech by O Frodel)

A. Discussion of the various phases of electro-erosive metal removal, including electro-spark, anodic-mechanical and electro-mechanical grinding and machining. The only subject not concerned with metal removal is the hard surfacing of tools by the electro-spark method. The booklet is based on talks held at a Czechoslovak conference in 1951, which have been supplemented by brief mention of some more recent developments. Although much credit is given to Soviet initiative in this field (the USSR is called the "motherland of electro-erosive metal removal"), almost all the machines described are Czechoslovak.

B. The use of these methods can lead to great economic advantages:

1) no more need of expensive silicon-carbide or diamond grinding media;
2) relatively low cost of new equipment;
3) old machines can be rebuilt in a relatively short time;
4) machining or grinding time in many cases a fraction of that previously required;
5) cutting life of sintered-carbide tools appreciably increased when ground by these methods;
6) many tools saved that would otherwise have been scrapped.

Czechoslovakia is said to have reached the "qualitative level" of the USSR in many fields of electro-erosive metal removal. Some steps to further the practical use of these methods in Czechoslovakia are discussed; these include suitable propaganda in newspapers, radio and films.

C. Credit is given throughout to various Soviet workers as the inventors of the various methods of electro-erosive metal removal. While the Soviets seem to have been the first to develop these types of metal removal to their present state, there is some question as to their claims of priority.

1) J Priestly in 1786 conducted experiments on the erosive effects of a spark discharge.

2) So-called "tap extractors" were introduced commercially in the USA prior to the time that electro erosive metal removal was publicized in the USSR. The suspicion has been expressed that Soviet developments in this field stem from USA tap extractors sent to the USSR during World War II.

3) Chudoba does mention a test comparing Czechoslovak equipment with a "Western disintegrator" of the Marbais-Elox type, wherein the performance of the Elox machine was stated to have been only about 10% of that of the best Czechoslovak types. He gives no indication, however, of the length of time such Elox equipment has been on the market; nor does he include sufficient information to permit evaluation of the test.

D. It is somewhat difficult to visualize the actual extent to which electro-erosive metal removal is being used in the USSR and Czechoslovakia.

1) Apparently the major usage in the USSR in 1951 was for grinding and machining of sintered-carbide tools and dies. Other uses of these methods for metal removal appear to have been less prominent. Electro-spark hard surfacing,

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however, is said to have been used in many plants for all tools. The importance placed on this development in the USSR is shown by the fact that four Stalin prizes have been awarded to workers in this field.

2) The supplement (which seems to give the stand in Czechoslovakia in 1953) indicates that the major applications at that time were electro-spark hard surfacing, cut-off tools, and removal of tools. Mention is made of the fact that the use of electro-erosive grinding had been slowed down because of low productivity of the machines and consequent long grinding times, and because of the "temporarily" increased sensitivity of sintered-carbide tips to cracking. The former is attributed to the use of rebuilt machines with insufficient power. No specific cause is given for the latter, but it is said to have been found with imported sintered carbides as well as with domestic grades.

E. Most of the interest in the USA in this type of metal removal has been in connection with the grinding and machining of sintered carbides with a major incentive the conservation of scarce diamond bort. On the other hand, the 25X1 [redacted] has also stressed the use of the electro-spark method for machining highly alloyed heat-resistant alloys and hardened steel. While there has been much experimental and development work in this field, there appears to have been as yet little commercial use in the USA of these various methods (apart from the established tap-removal types of equipment, such as those produced by Elox Corp).

1) Published work in the USA seems to cast some doubt on the Soviet and Czechoslovak claims of greatly increased cutting life of sintered-carbide tools ground by electro-erosive methods. Sparcatron Ltd, however, also claims increased cutting life. The validity of such claims would obviously depend on the quality of the grinding methods previously used.

2) The Soviet and Czechoslovak work emphasizes the scarcity of silicon-carbide grinding wheels. On the whole, much less mention is made of diamond wheels; and the only disadvantage of the latter is said to be expense. Since the raw materials for silicon carbide should be readily available, the only apparent reason for scarcity of silicon-carbide abrasives would seem to be inadequate plant capacity.

Minerals and Metals Advisory Board of the National Research Council: Report MAB-?8-M. 80 pp

N W Thibault and B H Anderson: Electrolytically-Assisted Diamond Wheel Grinding of Cemented Carbide. Technical Bulletin 526. Norton Co (1952)

A H Allen: Electro-Machining of Carbides and Other Hard Compacts. Metal Progress 62 (1952) no. 2, pp 87/89, 142

N W Thibault and B H Anderson: Grinding Carbide Tools With Electrolytic Assistance. Metal Progress 64 (1953) no. 2, pp 161/164, 166

D W Rudorff: Electro Spark Erosion as applied to Metal Machining. The Engineers' Digest 14 (1953) pp 373/377

G Comstock: Electrolytic Grinding - Its Status and Future. Paper presented at 18th Annual Machine Tool Electrification Forum and abstracted in Product Engineering 25 (1954) no. 6, pp 287/288

C P Porterfield: Electrospark Machining - Metal Removal Without Contact. Paper presented at 18th Annual Machine Tool Electrification Forum and abstracted in Product Engineering 25 (1954) no. 6, pp 288/290, 292

F. The electro-spark hard surfacing has previously been discussed in a review of Smirnov's paper, and in an earlier review of Yakimchuk. The present booklet makes far more extravagant claims than Smirnov did (some increases in cutting life

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"up to 1,000%"), but there is no documentation to back up these figures. From the apparent wide use of this process, however, it must be concluded that electro-spark hard surfacing does improve the tool life.

V P Smirnov: Electrospark Strengthening of Cutting Tools. Avtomobil'naya i traktornaya Promyshlennost' (1950) no. 12, pp 17/20
I Yakimchuk: Repeated Reconditioning of Worn Tools. Za Ekonomiyu Materialov 5 (Dec 1952) pp 72/74

7. Subzero Treatment of High-Speed-Steel Tools by A P Gulyaev, P P Grudov and A A Badaeva. Stanki i Instrument 20 (1949) no. 3, pp 3/6; no. 4, pp 16/18

A. An excellent paper. Two grades were investigated for effect of heat treatment on retained austenite; effect of rate of cooling from + 1,100 to - 79 C on the susceptibility to cracking; and effect of 12 variants of tempering and subzero treatment on cutting performance. Not all tests were made on both grades.

1) Subzero treatment has about the same effect as a temper.
2) The rate of cooling from room temperature to - 79 C has no effect on the susceptibility to cracking of quenched high speed steel, but the rate of cooling from + 1,100 C to room temperature has a marked influence. The faster the cooling rate in the latter range, the greater is the tendency to crack on subsequent cooling to - 79 C.
3) Subzero treatment may give a significant increase in cutting performance when the tool is quenched from a lower-than-normal austenitizing temperature or when only a single temper is used.
4) Practically, it may be expedient to use a subzero treatment in the mass production of tools as it counteracts the effect of inadequate control (fluctuations in austenitizing temperature; inadequate tempering). Technical and economic reasons, however, will govern as to whether the subzero treatment is to be preferred to an extra temper.

B. One of the grades tested (RF 1) was the conventional 18-4-1 high speed steel with about 18% W, 4% Cr and 1% V. The composition of the other grade (EI 347) is not known; the "normal" austenitizing temperature of this material, however, would correspond to that of a low-alloy or molybdenum high speed steel.

C. Gulyaev, Grudov and Badaeva are quite aware of the most pertinent USA work in this field and have included five USA references in a bibliography of 14 items. On the other hand, they have not included a relevant British paper.

K J B Wolfe: The Subzero Treatment of High Speed Steel, With Special Reference to Intermittent Cutting. Metal Treatment 13 (1946) pp 79/94,98

D. The discussion in connection with point A4 would indicate a highly inadequate temperature control in at least some plants making high-speed-steel tools.

E. When subzero treatment was first publicized in the USA, it was claimed to improve cutting performance markedly. More precise and better controlled tests, however, showed that it had a negligible effect on properly heat-treated tools although it would improve improperly heat-treated tools. (As a matter of fact, some of the current tool-steel catalogues do not mention high speed steel in their discussion of subzero treatments, but merely state that such a treatment may benefit high-chromium tool and die steels.) This present point of view is basically confirmed by the work of Gulyaev, Grudov and Badaeva.

F. Although many heat treaters have cooled high speed steel directly to subzero temperatures without cracking, other work has shown the possibility of cracks unless the tool were first tempered (which cuts down the effectiveness of the subzero treatment). Gulyaev, Grudov and Badaeva's tests on the effect of rate

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of cooling on cracking [illegible] the reason for at least some of the previous discrepancies: namely, the governing factor may be the rate of cooling just above room temperature. These tests of course explain why Gulyaev and Chaadaeva did not discuss this question in detail in their 1953 paper...see point 5 of previous review.

A P Gulyaev and [illegible] Chaadaeva. Stabilization of Retained Austenite During Cold Treatment of Steel. Vestnik Mashinostroeniya 33 (1953), pp 37/42

G. It is noticeable that the standard treatment for both high speed steels involves a triple temper (1 hr + 1 hr + 1 hr). More than two tempers are seldom used in the USA with standard high speed steels. As a matter of fact, some shops still use a single temper without an excessive drop in performance of standard lathe tools. Even Gulyaev, Grudov and Badaeva's tests show that the difference between a single and a triple temper was no more than 9% under their cutting conditions.

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